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Lubrication

THIS ISSUE

Modern Elevators

Types and Methods of Lubrication

Mineral Oil as an Egg Preservative

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Elevator Lubrication

THE problem of lubrication of elevator machinery is becoming of considerable importance to the engineering profession today. The ever-increasing demand for elevator service, as higher buildings are becoming more and more necessary to house the executive offices of our industries and store their products, has eliminated the heretofore popular idea that elevator machinery, especially of the electric type, could be lubricated in much the same manner as other types of gearing and general motor driving mechanisms. There are certain pertinent operating features which prevail that demand considerable cooperation between the elevator and lubricating oil manufacturers, and careful attention must be paid to these details and the manufacture and selection of suitable lubricants, if maximum efficiency of operation is to be attained, and durability of equipment insured.

Elevator lubrication is considered by many authorities to be a lubricating problem in itself. Few other types of machinery involving the same mechanical principles operate under such severe conditions, where starting and stopping is continuous and generally under heavy load. Especially does this hold true in the electric geared traction machine where the worm has to exert a starting torque approximately three times the normal, doing this when the oil has probably been entirely squeezed out from between the worm and gear.

TYPES OF ELEVATORS

There are six types of freight and passenger elevators in more or less common use today. These are the hydraulic plunger, the low pressure hydraulic cylinder rope-geared, the high pressure cylinder rope-geared, the electric drum, and the electric traction (geared and gearless) elevators.

The use of the hydraulic plunger elevator, while still prevalent in many fairly high buildings, is, however, considered as relatively obsolete for installation in new construction work. A great objection is the low efficiency obtained due to the fact that it operates under full load conditions constantly, regardless of the actual live load being carried. As a general rule it is limited to speeds of about 400 feet per minute, because of the difficulty of making accurate stops at higher speeds. Also it is limited as to travel by the excessive cost required to sink deep wells for the plunger cylinders.

First cost as well as space available for the installation, plays an important part in elevator construction. These two factors have both contributed to decrease the popularity of the hydraulic plunger elevator. It can be appreciated that the cost of sinking a cylinder as many as twenty stories into the ground will be relatively enormous if the sub-strata should contain rock layers, as are prevalent under so many of our large cities. Then again, since the operating mechanism for such an elevator is usually re-

quired to be in the basement, we can realize that the high and low pressure water tanks, the operating valves, and the pumping equipment will take up considerable valuable space. Compared with the modern electric (gearless) traction elevator where mechanism is generally installed above the shaft, the space required would be on a ratio of about five to one.

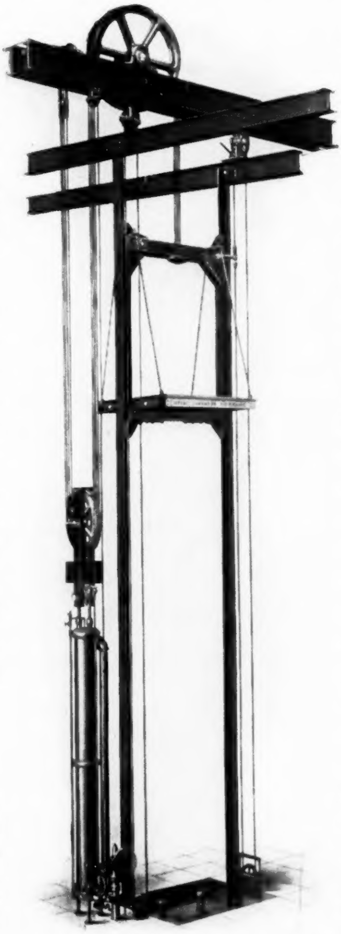
The low pressure hydraulic cylinder rope-geared type of elevator, in addition to involving certain of the above objections, is also limited by the space necessary for the cylinders. As a rule its efficiency is less and the cost of installation greater than the high pressure elevator of the same type. This latter is used for relatively high speeds and lifts.

Of the electric elevators, the drum type is limited to medium lifts on account of the necessary width and diameter of the drums on which the cable must coil. The geared electric traction type is universally used for speeds up to about 400 feet per minute, and short lifts. The traction gearless type is used almost entirely for higher speeds and the longer lifts prevalent in present day office construction, and is the most modern elevator equipment today.

It is with electric types of elevators that the Lubricating Engineer will most usually have to deal, and where specific problems of lubrication will generally be found.

The Hydraulic Plunger Elevator

In the hydraulic plunger elevator the car is lifted by means of a steel tube plunger actuated by water pressure of from 140 to 200 lbs. per square inch. This works in a pipe cylinder set in the ground within a steel casing. The plunger for usual service must be several feet longer than the distance through which the car is intended to travel, and the containing cylinder must be proportionately deep. This pipe cylinder is supplied with water, as necessary, at an inlet just below the stuffing box, through an operating valve usually of the balanced-piston type, fitted with leather cup valves. A pilot valve, operated from the car preferably by lever control, via an endless rope, actuates the main valve by such gearing arrangements as general construction may require. Limit valves in the supply and exhaust lines are operated automatically by ropes, when the car reaches the upper or lower limits. Lifting of the car is aided by the descending counterweight, ropes connecting this to the car, passing over fixed sheaves at the top of the shaft. Therefore, in descent the car must exert sufficient pressure to force the water out of the cylinder.



Courtesy of Otis Elevator Company

Fig. 1.—Typical Low Pressure Hydraulic Cylinder Rope Geared Elevator for freight service, showing vertical cylinder, lifting mechanism and operating connections. This is a simple form of short lift machines. High and low pressure water tanks are not shown.

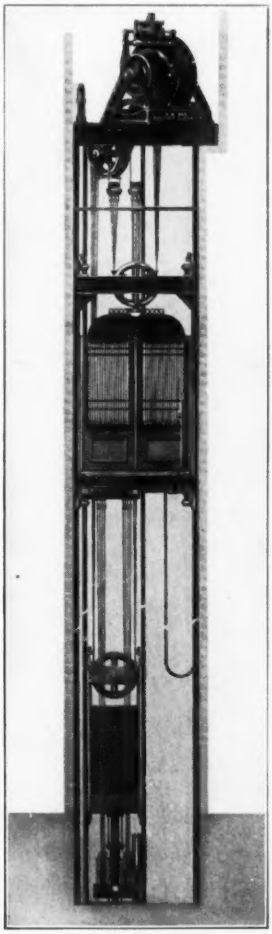
A brief description of the sequence in which this water power acts is interesting. The usual construction calls for two tanks, one high pressure, and one low pressure, suitably piped to the pumping set and control valves. Both tanks are filled with about 30% of air, which acts as a cushion, being supplied as desired from the water pump by admittance at the suction side. The high pressure tank carries the operating pressure of the system. When the car is to be raised suitable moving of the hand lever therein, and consequently the control rope, actuates the pilot valve which in turn operates the main valve, so as to permit water flow from the high pressure tank to below the plunger. When the car is to be lowered, by moving the hand lever in the opposite direction, the main valve is thereby moved accordingly to close the ports to the high pressure tanks, and allow the water in the plunger cylinder to pass via suitable ports in the valve chamber to the low pressure tank. The func-

tion of the pump, which is most usually steam driven, is to transfer this water from the low pressure to the high pressure tank where it is again available for use when required. Thus we have an endless sequence of water flow. Loss is practically negligible, so on an average but little make-up water is necessary and complete change of water in the system and cleaning of tanks is essential only about twice a year. In such a system the pumping set should be provided with automatic starting and stopping regulators which act when the high pressure tank reaches its minimum or maximum. The plungers of hydraulic elevators are generally from 5″ to 7″ in diameter, depending on the length.

In certain systems, open tanks may be located on the roof if the height is sufficient to give the required hydrostatic pressure for operation. Again, installations for low lift may even discard tanks altogether, using city water direct, if it is under adequate and dependable pressure.

Hydraulic Cylinder Rope-Geared Type

This type of elevator (known also as the vertical low pressure) has been a favored substitute for the Hydraulic Plunger Machine under conditions where there was more shaft space than floor area available, and excavation would have been difficult. A popular type of such an elevator consists of a vertical cylinder of about 30 feet in length, closed on the bottom. A suitable piston is attached to two piston rods usually, which pass through stuffing boxes in the top. These rods are fixed by yoke and frame to suitable traveling sheaves installed overhead, their arrangement depending on the desired car travel with respect to the piston travel, and the lifting capacity required. The principle involved is essentially that of the block and fall. To raise the car, water is admitted by a suitable valve arrangement to the cylinder at the top, thereby forcing the piston down. To lower the car, this water is allowed to escape, its rate of flow being controlled by a main valve which is operated by a pilot valve manipulated from the car by a suitable rope. Automatic top and bottom limit stops are provided to shut off the water when the limits are reached, and relief valves are installed in the exhaust to allow for the passage of the water from the bottom to the top of the cylinder, if the stop is too sudden.



Courtesy of A. B. See Elevator Company

Fig. 2.—General elevation of an Electric Gearless Type Elevator. This is the most popular equipment today for high speeds and high lifts. Connections from car to hoisting mechanism and counterweight are clearly shown.

Other variations of the hydraulic elevator are the horizontal cylinder pulling and pushing types. Their operation is similar to the vertical type, except that an independent counterweight is used in place of the movable sheaves, piston and rod. In the pushing type the fixed sheaves are supported on the back head of the cylinder and the piston connected to the traveling sheave so as to push them apart.

High Pressure Cylinder Rope-Geared Type

These elevators operate much the same as the low pressure type, but under water pressures of from 700 to 800 lbs. per square inch. Thus the size of piping and cylinders can be reduced and they are adapted for high speed service.

The Electric Drum Elevator

This type of elevator, which is chiefly used for short or medium lifts, may have its hoists mounted either at the top of the shaft or in the basement, the former having the advantage that less rope is needed. They may be single or tandem-geared. In the tandem-geared machine the motor drives a shaft which carries a right and left hand worm. These worms mesh with the gears which also mesh with each other.

Thus end thrust on the worm shaft is eliminated. The drum is bolted rigidly to one gear. The car is balanced by a counterweight attached to cables fastened to the drum on the opposite side from the hoisting rope. The travel of the car is maintained within the safety limits by automatic limit stops attached to the drum.

The Electric Gearless Traction Type

This is the most modern elevator today, and is used for high speeds and high lifts. The range of lifting capacities and minimum and maximum speeds of such a machine will depend on the roping ratio. For example, given a ratio of 1:1—the lifting capacity will be from 2,000 to 3,500 lbs. at a minimum speed of 450 feet per minute, and a maximum of 700 feet per minute. On the other hand, if geared at 2:1, the lifting capacity will be doubled and the speed halved. Such an elevator consists essentially of the car, counterweight, and a slow speed motor which is rigidly connected to a traction or driving sheave. The ropes attached at one end to the car, pass over the driving (and such secondary or guide) sheaves as are installed, and are made fast at the other end to a counterweight. An inherent safety feature is prevalent due to the reduction in tractive effort of the driving sheave on the ropes, when the car or counterweight reach the limit of travel, and the ropes slacken. In very high lift elevators the effectiveness of this safety feature will be decreased on account of the dead weight of the ropes producing sufficient traction to cause over-travel, which might be of considerable danger.

The Electric Geared Traction Elevator

In this machine the mechanism consists of a worm gear, or in some cases a herringbone gear, rigidly connected to the driving motor shaft, and located sometimes above but usually below the driving gear. The entire gearing is generally built enclosed in an oil tight casing, gear and traction sheave connections being so designed as to allow of no lost motion. End thrust may be taken up by an arrangement of double gears meshing with right and left handed worms. With single gear construction this thrust exerted by the worm is taken up by either a disc and button thrust bearing on each end, or a single or double acting roller or ball-thrust bearing. In modern construction the double acting thrust bearing is located at the rear end of the worm shaft, where thrust in either direction is taken up. Side thrust exerted by the worm on the gear bearing is taken up by a roller or ball thrust bearing, or the groove type of marine bearing. Gears are usually constructed of bronze, the worms being of steel. This machine varies in its lifting capacity normally from 1,000 to 10,000 lbs., and has a speed ranging from 100 to 500 feet per minute. Motor drive may be installed to use either direct or alternating current.

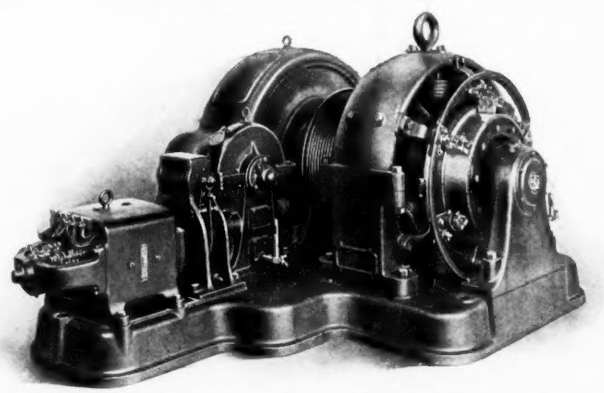
The relative advantage derived from a geared machine is lower cost of installation due to ability to use the cheaper high speed type of motor. In turn it possesses certain operating disadvantages which are important:

(a) Greater difficulty in obtaining smooth action due to inability to construct gears perfectly and in absolute alignment.

(b) Greater care in selection and use of lubricants is necessary.

(c) Frequently greater current consumption is required.

(d) In some types of machines brakes must be designed to dissipate the kinetic energy which is stored in the armature. As a result of this the normal life of brakes is decreased.



Courtesy of Otis Elevator Company

Fig. 3.—Type of Modern Gearless Traction Operating Mechanism. This machine is known as the Micro-Leveling Elevator. Accurate landings are automatically made and not controlled by either the operator or any push button operating device after the car has reached the limiting zone above or below the landing. Within this zone cams located in the hatchway direct the operation of the machine at reduced speed till the platform is exactly level with the floor. This level is automatically maintained irrespective of change in load.

LUBRICATION

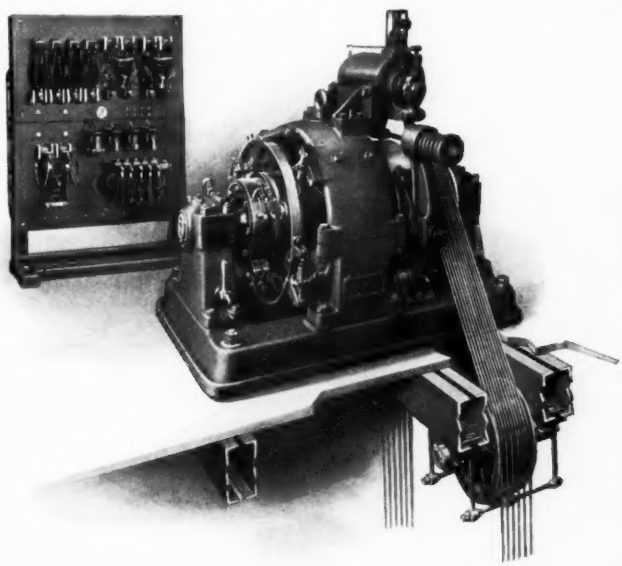
Practical lubrication of elevator machinery can best be discussed under two general headings, i.e., as applied to

Hydraulic Elevators, and
Electric Type Elevators.

Hydraulic Type

Lubrication of such equipment is relatively simple, being confined to plunger (or piston rod), pumping system, sheave bearings, and control valve, etc. Usual practice in the case of the first is to coat it periodically with a good grade of a pure mineral lubricant having a viscosity of about 1000″ at 210° F. (Saybolt) to insure free sliding through the cylinder stuffing box.

Pump lubrication is similar to usual practice in general pump operation. In a steam driven unit the selection of a steam cylinder lubricant is of importance. This should be a compounded product, of a high grade steam refined cylinder stock with 6% to 8% of fixed (animal) oil added to insure proper emulsification and sticking of the lubricant to the cylinder, etc. in the presence of moisture, which will be present practically always, however dry the steam at admission. External parts, such as rocker arms, etc., can well be lubricated with a good grade of red engine oil, of about 300″ to 500″ (Saybolt) viscosity at 100° F., applied either by hand or preferably by sight feed oil cups. Plungers or piston rods on the water sides of such pumps require no lubrication other than they naturally receive from the water itself, which is treated with an emulsifying compound periodically.



Courtesy of Otis Elevator Company

Fig. 4.—Typical Electric Gearless Elevator Operating Mechanism, showing clearly the arrangement of roping over the driving and secondary sheaves. This is an example of 2 to 1 roping. Control panel and electric braking mechanism are also shown.

The necessity for so treating the water used in a hydraulic system is to cause precipitation of fine grit and impurities held in suspension which would cause excessive wear on packing valves, etc. It also enables the water to contain in an emulsified state a certain amount of lubricant in order that the control valves, which are chiefly leather cups, will be kept in a soft pliable condition and not deteriorate too rapidly. Usual practice requires addition of this compound at bi-weekly intervals. Soluble oil will meet the requirements of such service admirably.

Lubrication of sheave bearings differs very little from usual practice. Inspection and maintenance of lubricating equipment are most important. The lubricant to use should be a good grade of red engine oil of from 300″ to 500″ viscosity at 100° F. on the Saybolt instrument. Hand oiling is frequently the custom, but the use of sight feed oil cups or a chain oiling system is considered best practice.

Other parts requiring lubrication in a hydraulic system are the controlling mechanism for the operating valves, and the guides for the counterweight and car. The former, if of rack and pinion type, should be preferably lubricated with a good grade of gear compound, with a viscosity of about 200″ Saybolt at 210° F. On the counterweight shoes, etc. for insuring lubrication in the guides, grease cups are preferable, a medium bodied compression cup grease that will not drip or run off being the best lubricant.

On such surfaces there is no extensive pressure brought to bear, and the necessity of a lubricant is simply to insure perfect sliding contact and to overcome any inequalities of surface that may exist either on the shoes or guides.

Electric Type

The subject of electric elevator lubrication can be sub-divided into the treatment of electric traction gearless machines, traction geared machines, and drum type elevators. The essential differences will be in the hoisting mechanism. In the gearless type of traction elevator, the motor bearings and sheave bearings are the principal features. Construction will determine the manner of lubrication. With straight collar type bearings built for chain or ring oilers, the problem is simply that of keeping the oil wells properly filled with a good grade of engine oil, having a viscosity of about 300″ Saybolt at 100° F. On the other hand, certain types of machines that involve roller bearings, require that the roller bearing housing be packed with a heavy compound of pure petroleum nature, using only soap stock when necessary to meet temperature conditions. Though there is no sliding contact in a roller bearing, the pressure at the points of contact is relatively high. As a result a high instantaneous temperature is prevalent.

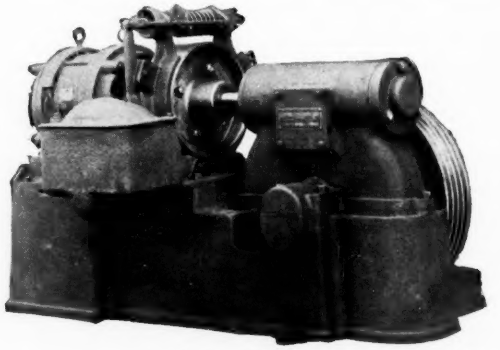
Worm Gear Lubrication in a drum type or geared traction elevator, involves probably the most important and exacting condition in the entire industry. A suitable lubricant for this purpose should possess certain qualities that do not usually pertain to other oils.

(a) Primarily it should be of sufficient body to withstand the excessively high pressure at the point of contact, thereby to prevent actual metal to metal friction occurring between worm and gear.

(b) The lubricant should be entirely free from acids or alkalis which would tend to cause a certain amount of pitting on the metallic surfaces covered, particularly the polished steel roller or ball thrust bearings. In turn the lubricant should not be affected by heat, water, acid or alkali.

(c) As low a pour test as possible is desirable in order that the oil may be used in colder climates without abnormal congealment and excessive power consumption on first starting under very cold conditions.

Opinions of authorities on worm gear construction, operation and lubrication, differ as to the most suitable type of lubricant to meet



Courtesy of Turnbull Elevator Company, Ltd.

Fig. 5.—Type of High Speed Overhead Drive Geared Traction Elevator Mechanism. The overhead drive is being given considerable attention today for certain types of work. Electric braking mechanism is shown at the left of the gear case. This is a direct connected, single wrap machine. The worm shaft is mounted on ball bearings which take both thrust and radial loads.

the above requirements. Many contend that the oil should be a pure mineral product with no animal or vegetable oils compounded therewith; the objection being that the latter under the excessive pressures and temperatures which prevail would have a tendency to break down, gum and clog the roller or ball thrust bearings. For the same reason, these gentlemen urge that fillers such as graphite, etc., should not be mixed with the lubricant as a thickening medium. For such purposes they recommend the use of a high grade steam refined cylinder stock having a flash point around 600° F. and a viscosity of about 150″ Saybolt at 210° F. Most modern practice is, however, to use a pure mineral oil having a viscosity around 120″ at 210° F., but with a pour test much lower than that of cylinder stock.

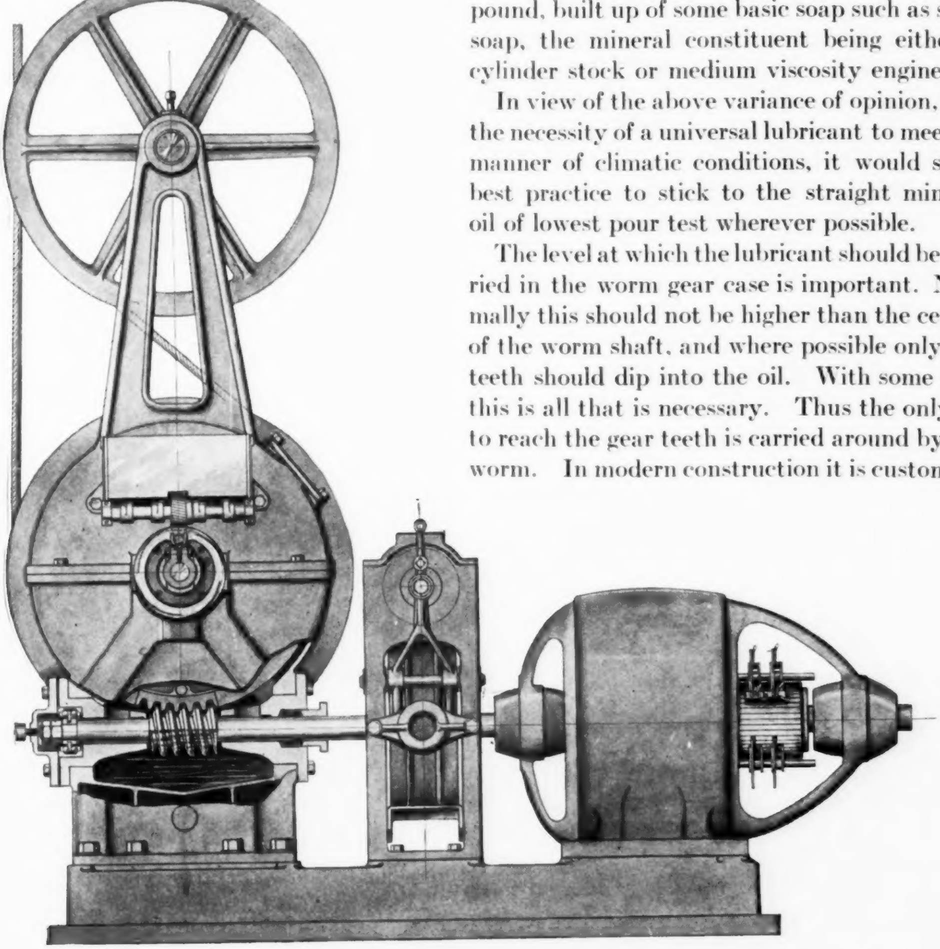
The matter of the compounding with a fixed oil (especially a vegetable oil such as castor) is interesting and a point that should be given further consideration. Quite as many reputable engineers maintain that to make a worm gear lubricant which will embody the above characteristics, a certain amount of fixed oil (preferably castor) must be compounded with the basic mineral oil. As high as 50% of the former is recommended by some. In such a

compound the mineral base is preferred to be a cylinder stock. On the face of it this would seem an excellent compound. The presence of castor oil would result in the desired flatter viscosity curve, free fatty acids would be absent, and the body or viscosity of the resultant compound would be such as to admirably meet pressure conditions. The pour test on the other hand, is not lowered to any extent. However, to attain a perfect mixture between castor oil and a mineral oil, with any extensive percentage of the former, is extremely difficult without the use of a third component. Even then such a mixture can not be depended upon. Another important point is the fact that the greater percentage of so-called castor oils on the market today are not the pure product but imitations, such as aluminum soaps or blown cottonseed oil, masquerading under the name of castor. Assuming pure castor oil were used, in all probability, notwithstanding that a seemingly complete mixture might be started with, agitation of the lubricant, its continual draining down the casing walls, and the fact that the worm dips in but part of the entire oil in the well, would tend to cause a separation. Once started, it can be seen that the worms would continually be carrying less and less of the heavy component oil and more and more of the light, till ultimately, the latter would be doing practically all the work.

There are, in turn, other engineers who prefer and recommend the use of a light grease compound, built up of some basic soap such as soda soap, the mineral constituent being either a cylinder stock or medium viscosity engine oil.

In view of the above variance of opinion, and the necessity of a universal lubricant to meet all manner of climatic conditions, it would seem best practice to stick to the straight mineral oil of lowest pour test wherever possible.

The level at which the lubricant should be carried in the worm gear case is important. Normally this should not be higher than the center of the worm shaft, and where possible only the teeth should dip into the oil. With some oils, this is all that is necessary. Thus the only oil to reach the gear teeth is carried around by the worm. In modern construction it is customary



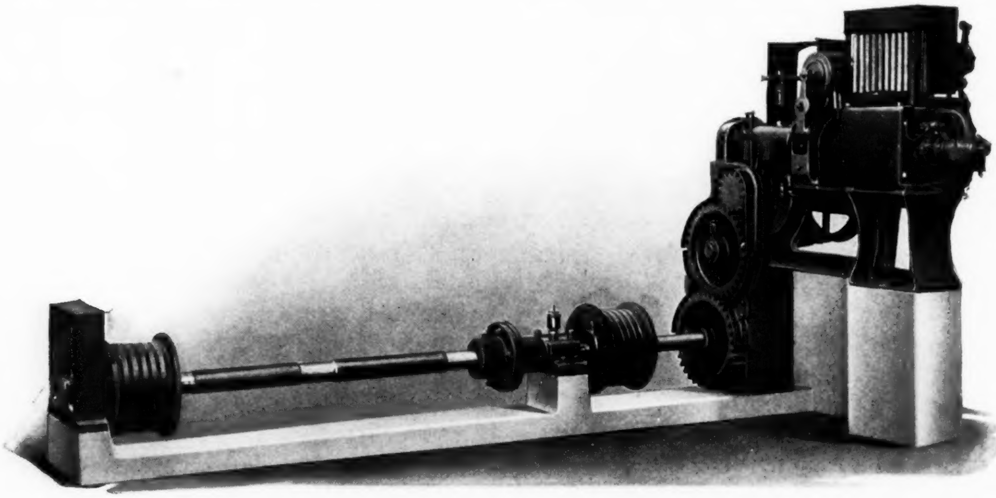
Courtesy of Turnbull Elevator Company, Ltd.

Fig. 6.—General layout of an Electric Drum Type Passenger Elevator, showing in phantom the interior of the worm gear case, and Electric Drum. End thrust of the worm is taken up by a double acting ball thrust bearing. A packed gland is provided at the other end of the worm shaft to prevent leakage of oil from the gear case along this shaft. The braking mechanism is of the electric type and is shown between the gear case and the motor.

to control the height of oil in the gear case by the installation of an external overflow in the base. The gear, running at relatively high speed, throws any excess oil to the side of the casing where it runs down, either back to the reservoir, or to lubricate the gear bearings, which in some installations are fitted with ring or chain oilers as well. The popular idea of running the worm fully submerged in oil is being gradually discarded. The action of the worm is similar to that of a screw pump, hence the resultant high pressure to which the oil is subjected, would tend to cause excessive leakage along the shaft. To guard against this, a grease cup is installed on the stuffing box in many installations. Thus a seal of heavy lubricant is obtained and at the same time, the shaft is properly lubricated. For such purposes a relatively hard grease is recommended. Normal good practice in the absence of grease lubrication, allows for a very slow rate of oil leakage from the rear stuffing box of the worm shaft, to insure sufficient lubrication of the latter.

The driving sheave bearing should be lubricated with the same oil as the worm gear where possible. This shaft is common to the main gear shaft and is subject to heavy pressures, i.e., in the neighborhood of 400 lbs. per square inch. Hence the requirement of a heavier bodied lubricant than other sheave bearings. On the other hand, the efficiency of the entire machine should never be jeopardized in an effort to stick to one oil only. If the gear lubricant is such as to be unsuitable for such bearings, a separate oil such as a 500″ or 750″ viscosity engine oil should be used.

Lubrication of counterweight guides, brake mechanism and other minor external wearing parts involves no difficulties. The matter of guide lubrication has been discussed under Hydraulic Elevators. Other points such as brake parts, governor, etc., can either be lubricated by hand or sight feed oil cups, using the same oil as on the motor bearings. Certain installations include grease cups for this purpose, in which event a good medium bodied compression grease will be found very satisfactory. Safety devices, such as of the roller wedge block type, etc., while normally inoperative, yet should be regularly inspected and lubricated so as to insure prompt and efficient operation if required.



Courtesy of A. B. See Elevator Company

Fig. 7.—Typical sidewalk Hoisting Machine, involving worm gear drive through a suitable train of gears. This machine is usually located below the car. Four corner drive is customary in order to assure that the car will come even with the floor on all corners. Manner of lubrication is clearly shown.

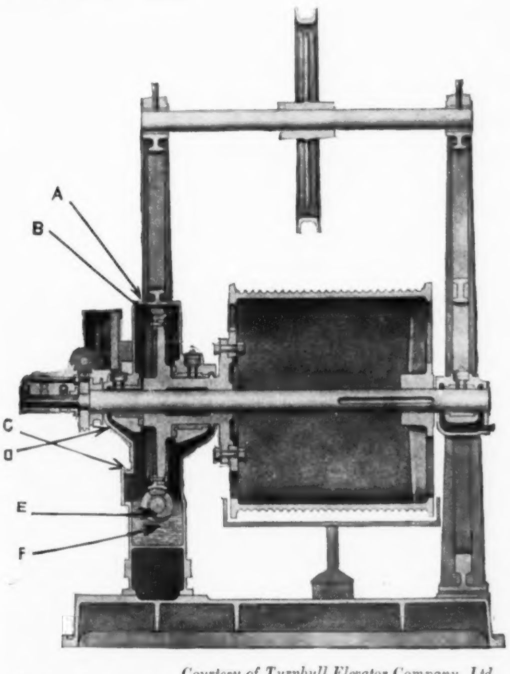
Wire Rope Lubrication

The question of wire rope lubrication is general, and applicable in its consideration to all types of elevators. Opinion as to the necessity of using a wire rope lubricant on elevator ropes differs. All agree, however, that under no consideration should the ropes be allowed to rust. Under continued operation this will not be so

apt to occur as when idle for any length of time. Using a rope the core of which has been treated with a lubricating compound, active operation will tend to cause this compound to ooze out and assure that the metallic strands will have a sufficient coating to prevent entry of moisture or dust. As a rule, elevator machinery is so housed that exposure to moisture, the weather, steam, corrosive vapors, etc., will not be excessive. On the other hand, elevators in service in industrial plants where such detrimental features are most prevalent, are subject to longer periods of inaction. Therefore, periodic external lubrication of wire ropes in such cases is a necessary procedure. The lubricant for such service should possess certain distinctive properties:

(a) It should not harden, nor contain any residual matter that is of a non-lubricating character.

(b) It should have a high penetrative property, in order that it can work its way between individual metallic strands, to lubricate the interior of the rope and prevent water or other destructive elements from coming in contact with the strands.



Courtesy of Turnbull Elevator Company, Ltd.
Fig 8.—Cross-sectional view through winding machine of an Electric Drum Type Elevator. Manner of lubrication is clearly indicated.
Key: "A" Upper Gear Housing "B" Bronze Worm Wheel Rim
"C" Lower Gear Housing "D" Oil Passage
"E" Worm "F" Oil

(c) It should possess a highly adhering property, in order not to drip or flow excessively under abnormal temperature rise, nor to be scraped or rubbed off under operation.

Experiments have proved that such a lubricant should have a viscosity of from 1,000 to 2,000″ at 210° F. on the Saybolt viscosimeter. Its method of application is important. The best procedure is to apply the lubricant hot, using a split box which contains the former, and through which the rope is allowed to run. Thus a light film is applied, waste is decreased and the entire surface is properly and evenly covered.

Courtesy A. B. See Elevator Co.
Fig. 9.—Typical Counterweight and Guide Arrangement, indicating manner in which weights are applied and general construction features.

An example of the value of a suitable wire rope lubricant was recently brought out in the case of a traction gearless elevator. Due to cramped quarters in the building above the shafts, certain of the machines were set staggered, with the secondary sheaves offset so that the ropes in passage from the driving sheaves ran on an angle of about 30°. Under such conditions a certain amount of slippage occurred due to loss of traction at the driving sheave. In an effort to remedy this, wire rope lubricants having the properties described above were experimented with. Final correction of conditions was obtained, using an extremely heavy lubricant having a viscosity of 5000″ (Saybolt) at 210° F.

To attain maximum traction and insure as far as possible against slippage, it is considered best practice in sheave construction today to cut the base of each groove somewhat smaller

in diameter than the rope, then to bevel the straight sides of the groove to about an 80° angle. Thus two points of contact between rope and groove occur, as compared with one such point in a simple U groove, and traction is thereby materially increased.

Conclusion

In closing it is safe to say that continuous operation is the most essential factor in elevator service. It can be realized that one or more elevators out of commission, on account of mechanical defects, etc., might involve extensive delay in the handling of rush passenger loads at certain hours of the day in a large office building. No feature in the management of such a building will call for more complaint from the lessees than inadequate elevator service, which might cause the employees to reach their work late or even be compelled to resort to the stairways in extreme cases. Particularly in high buildings of 15 or more stories, the use of stairways is a physical impossibility to many people. Therefore, the elevators must be kept in perfect condition at all times. We can readily understand how an improperly lubricated worm gear, bearing, pump or hydraulic control valve mechanism might give rise to such extensive damage that the unit involved would have to be cut out of service for a considerable period in order to repair the same. The type of lubricant used for any specific purpose plays just as important a part as the manner in which it is applied. Both must be suited to each other and to the service demanded. Especially in regard to worm gear lubrication is there ample room for extended study, research and cooperation on the part of the elevator trade and the oil industry. The present state of varying opinions should be cleared up and a grade (or grades) of lubricants developed that all concerned will agree upon as most suitable for this exacting service.

Finally, in order to insure that your elevator equipment is properly operated, assuming that the lubricants and their means of usage are adapted as completely as possible to the service required, etc., it is essential that thorough inspection be made of the various parts at frequent and regular intervals. In fact, to protect their machinery and name in the trade, certain elevator manufacturers recommend the adoption of a "maintenance contract" by their clients. The extent of same naturally is governed by local conditions.

Fuel Oil for Heating Homes

THE problem of heating homes with fuel oil was discussed briefly in the July number of LUBRICATION. So many inquiries have been received on this topic since then that it has been thought advisable to go into this subject in greater detail.

The era of househeating by use of fuels such as kerosene or gas oil, etc., is relatively new. Many home-owners are installing such systems today to avoid the disagreeable featu--- that coal involves. In these installations not only operation but certain precautions must be considered.

Operation

Primarily are we concerned with the operative economy of oil as compared with coal. This will depend on the oil-equivalent of coal, the type of burner used, and cost of the oil.

(a) The oil-equivalent of coal for a house-heating furnace is difficult to estimate accurately. In an ordinary coal-fired furnace there is likely to be considerable waste of fuel through the grates as well as in the periodic banking and cleaning of fires. Assuming equal furnace efficiencies with 11,000 heat units per lb. for anthracite coal, and 136,000 heat units per gallon for an oil such as kerosene, this oil-equivalent would be about 162 gallons per ton of 2,000 lbs. As efficiencies vary, the oil-equivalent will be correspondingly affected. See problem 6, page 84, July, 1922 issue of LUBRICATION.

(b) A burner in which the fire is controlled by some thermostatic device is undoubtedly more economical than a hand-controlled fire, as wide variations of temperature and consequent losses of fuel are avoided. Such uniformity of temperature, as well as the cleanliness of the entire system, naturally add to the economy of operation and the comfort and health of the occupants of the home.

Precautions

1. Be sure that the apparatus is installed in accordance with the regulations of the Board of Fire Underwriters, and your local Municipal authorities.

2. Inspect the system daily to see that everything is operating properly, and that the pilot light tip (where used) is free from carbon. Never hunt for leaks with a candle or any naked light.

3. In installing a new system be sure that all flues have been cleaned out and dampers are open wide before starting up.

4. Keep all papers, rags or other rubbish out of the furnace room.

5. Do not allow unignited oil to spray or drip from the burner into the furnace at any time. This oil may collect on the furnace floor and result in the accumulation of combustible gases which may cause an explosion when the burner is lighted.

6. Allow no one to experiment with the apparatus.

7. Wherever a motor is installed, inspect the bearings for proper lubrication twice a week. These are usually ring oiled and will require addition of new oil about once a week, and cleaning out of the oil wells about once every three months. A light motor or engine oil of about 300″ Saybolt viscosity at 100° F. is suitable for such lubrication. This oil may also be used on other wearing parts of the system.

8. It is advisable to thoroughly overhaul the equipment at the beginning of each heating season. This should preferably be done by the company that installed the burner, which usually maintains a service department for this purpose.

Oil Supply

From the standpoint of the consumer the most desirable form of oil delivery is by tankwagon directly into the storage tank. At present kerosene is the only fuel available for wide distribution in this manner. Other grades of oil are at times obtainable by tankwagon delivery in certain localities but the supply is not dependable. The cost will depend on the grade of oil, method of delivery and distance from point of supply.

NOTE.—Typographical error in July issue, Page 84, 1st Problem: Oil required per B.H.P. hour should be 2.28 lbs. instead of 22.8 lbs. This affects the following two computations, the results of which should be .286 gallons and .684 lbs. respectively.

Mineral Oil as an Egg Preservative

THE use of mineral oils in the preservation of eggs to seal the pores of the shells and render the shell membrane impervious to gases and vapors, has recently been investigated* in comparison with other sealing agents. The tabular results following are of considerable interest. The relative efficiencies of the various sealing agents for preventing loss of weight by the escape of water vapor from within the shell during cold storage, the development of characteristic odor and taste, weakening of the membrane surrounding the yolk and alteration of the consistency of the white, etc., as calculated, indicate the evident superiority of mineral oils for this purpose.

The sealing value of the latter, as data indicates, seems to bear a definite relation to grade as characterized by viscosity, gravity and flash point, etc., and with equal sealing value, mineral oils, it is believed, should be better than vegetable oils since they would be less liable to

*"A Study of Methods of Minimizing Shrinkage in Shell Eggs during Storage." By L. H. Almy, H. I. Macomber and J. S. Hepburn, Food Research Laboratory, Bureau of Chemistry, U. S. Dept. of Agric., Pub. in The Jour. of Ind. and Eng. Chem. Vol. 14, No. 6.

impart odor or taste, or be subject to change during storage. The value of any oil as a sealing agent depends on its odor, tendency to turn rancid, viscosity, and its drying properties. The first two features, as might be expected, would render an animal or vegetable oil less dependable than a mineral oil of the same sealing value.

In further investigation the efficiency of mineral oils was markedly increased by the addition of about 1% to 2% of soap. Nothing was gained, however, by addition of gums, wax or rosin to relatively heavy mineral oils. Adding 1 gram of soap to 100 cc. of mineral oils A, B and D (see table) lowered the loss in treated eggs from 7.4, 8.6, and 44.4% to 6.2, 3.7 and 14.8% respectively. Addition of 2 grams of soap to 100 cc. of Mineral Oil "C" lowered the loss from 35.8 to 6.2%. Therefore, it is evident that soap will effectively close the pores if applied in a suitable medium.

"TABLE SHOWING EFFECT OF IMMERSION OF EGGS IN DIFFERENT KINDS OF OILS

Immersion Fluid	Method of Treatment[1]	Loss in Weight Per Cent	Comparative Loss in Treated and Untreated Eggs (Untreated = 100)
At End of 5 Weeks' Storage at Room Temperature			
Cottonseed Oil	I	0.5	6.3
Linseed Oil	I	0.6	7.5
Neat's-foot Oil	I	0.8	10.0
Peanut Oil	I	1.0	12.5
Untreated	..	8.0	100.0
At End of 12 Days' Storage at 40° C.			
Mineral Oil "A"	II	0.6	7.4
Mineral Oil "B"	II	0.7	8.6
Mineral Oil "C"	II	2.9	35.8
Mineral Oil "D"	II	3.6	44.4
Untreated	..	8.1	100.0

[1]In Method I the eggs were immersed for 5 seconds in the fluid at 153° C., cooled for a few seconds in a bath of the same fluid (33° C. average), wiped gently with sterile gauze, and placed in a metal container. In Method II the eggs were immersed for 7 seconds in the fluid at 115° C., then cooled for a few seconds in a bath of the same fluid (24° to 30° C.) allowed to drain without wiping, and placed in strawboard cartons.

MINERAL OILS.—The mineral oils employed in this experiment varied widely in efficiency. Mineral Oil "A" had a specific gravity of 0.869, a flash point of 365° F., and a viscosity at 100° F. of 134 (Saybolt units). Mineral Oil "D" had a specific gravity of 0.851, a flash point of 255° F., and a viscosity at 100° F. of 44 (Saybolt units). The other two mineral oils were intermediate in composition between "A" and "D". The heavier oil (A) gave the best results. Equally good, and perhaps better, results might be obtained with slightly heavier oils."

Another Crater Triumph

FROM the fields of its first and greatest successes in the steel and cement mills, on gearing, wire ropes and as a metal preservative, *Crater Compound* has graduated to a sphere even of more importance,—from the housewife's viewpoint. As a rat catcher it has proven its worth.

This remarkable domestic usage was developed in the steel industry, due to the excessive supply of rats which usually exist. Food scraps carelessly thrown about by the men, and the suet which is still much in use as a lubricant for roll necks, form an admirable menu for Br'er Rodent. The latter in particular attracted him when the industrial depression reduced the number of lunch baskets, and caused the owners of those remaining to use the contents more completely for their personal subsistence.

To combat this encroachment on the suet supply, in one plant the officials made a study of the rat-catching science, traps proving ineffectual as a rule. *Crater Compound* solved the problem. Shallow boxes, perhaps two feet square were made and a thin layer of Crater Compound about ½" to 1" thick was put in the bottom. In the center was placed a tempting morsel of cheese. In the morning six to twelve rats were to be found in each box. Usually the rats were dead—worn out in their struggle for freedom. This fact may be of interest to timid brides, who might not be accustomed to handling the animals alive.

In the case of an open suet barrel, it was necessary to resort to the use of camouflage; for in spite of a wide ring of Crater placed around the barrel on the floor, the rats would somehow manage to jump the ring or by some means gain access to the barrel. Accordingly a sprinkling of lime was placed on the Crater and the animals were deceived by the apparent solid white surface so that the results were as hoped for.

So ladies "Have you a little Crater in your home?"

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TEXACO LUBRICANTS FOR ELEVATORS

A SUGGESTIVE LIST

giving recommendations for various parts of most commonly used types of elevators

HYDRAULIC ELEVATORS

Plungers or Piston Rods — Texaco Crater Compound No. 1

Pumping System:

Steam Cylinders: Texaco Draco Cylinder Oil or Texaco Pinnacle Cylinder Oil
External Lubrication: Texaco Aleph Oil or Texaco Altair Oil

Emulsifying Compound for water in the System: Texaco Soluble Oil
Sheave Bearings: Texaco Aleph Oil or Texaco Altair Oil

Control Operating Mechanism:

Gear Teeth, etc.: Texaco Thuban Compound
Other operating parts: Texaco Aleph Oil or Texaco Altair Oil

Guides:

For Grease Cup Service: Texaco No. 1 Cup Grease
For Hand Application: Texaco Thuban Compound

ELECTRIC ELEVATORS

Gearless Traction Machines:

Motor and Sheave Bearings:

For Chain Oiling Systems: Texaco Aleph Oil
For Roller Bearings: Texaco Petrolatum

Geared Traction Machines:

Motor and Sheave Bearings: Same as above
Worm Gears: Texaco Thuban Compound B
For Grease Cup Seal and Lubrication of Worm Shaft: Texaco No. 2 Cup Grease
Driving Sheave: Bearing lubrication in special cases, if ordinary gear lubricant is unsuitable, use Texaco Altair Oil or Texaco Ursa Oil.

Guides:

For Cup Grease Service: Texaco Cup Grease No. 1
For Hand Application: Texaco Thuban Compound

Safety Devices: Texaco Aleph Oil

WIRE ROPE LUBRICATION

Texaco Crater Compound No. 2 for ordinary conditions
Texaco Crater Compound No. 5 where a very heavy lubricant is recommended

NOTE: If the grade of oil to use for any specific part or machine is not covered in the above list, kindly call on us and we shall be glad to tell you the right oil to use.

If your elevator is operating under unusual conditions which require individual treatment, let us know the name of the manufacturer, the type of machine, the general operating conditions, and we shall be glad to advise you as to the right Texaco Lubricant which will give you the best possible service.